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PROCEEDINGS OF THE
PHILADELPHIA FOUNDRYMEN'S ASSOCIATION.

The seventh annual meeting of the Foundrymen's Association was held at the Manufacturers' Club in Philadelphia, on Wednesday, November 2, the president, P. D. Wanner, presiding.

The executive committee reported as follows:

"Your committee would report, after reviewing a considerable amount of correspondence, that the foundry business is in a very much better condition than it was at this time last year. While there is no boom the volume of business seems to be growing gradually, and there is a better feeling existing. Western shops seem to be favored with more work than eastern shops, and the shops making heavy machinery and large work are probably busier than the shops engaged in the general jobbing business. The malleable iron and steel foundries seem to have all they can do. The outlook is very promising and there will no doubt be enough work offering to keep a great majority of the shops very busy.

"There appears to be more trouble than usually experienced in the matter of getting good molders. Almost every day we notice advertisements in our daily papers asking for good molders and core makers. This in itself is an indication that times are good with us."

The officers for the ensuing year were elected by a unanimous vote, which was taken under a motion duly made and carried. The officers are as follows:

President, P. D. Wanner, of Reading Foundry Company, Limited, Reading, Pa.

Vice-President, A. C. Pessano, of George V. Cresson Company, Philadelphia.

Treasurer, Josiah Thompson, J. Thompson & Co., Philadelphia.

Secretary, Howard Evans, J. W. Paxson Company, Philadelphia.

Executive committee, Walter Wood, chairman, R. D. Wood & Co., Philadelphia; Thos. Glover, Glover Brothers, Frankford, Philadelphia; E. E. Brown, E. E. Brown & Co., Philadelphia; Stanley G. Flagg, Jr., Stanley G. Flagg & Co., Philadelphia; Wm. F. Sauter, G. Rebmann & Co., Philadelphia.

The committee to whom the question of authorizing the establishment of a fund from which to provide medals or other awards for processes on improvements in foundry practice in conjunction with the Franklin Institute was referred reported progress.

A discussion, "Who is responsible for the cost of patterns in the case of a fire in a foundry," arranged to be held on this evening, was referred to the next meeting. The discussion was suggested by the fact that a law suit was recently instituted against the proprietors of a foundry by a customer for the recovery of $25,000 damages for loss of patterns by fire while deposited at such foundry.

A paper, "A Modern Foundry in Europe," and which formed part of the proceedings of the Detroit convention of the American Foundrymen's Association, and which was printed in the Journal for June, 1897, was again read by J. A. Penton, and the original lantern slides, 26 in number, shown by the stereopticon. The exhibition was much appreciated and enjoyed.
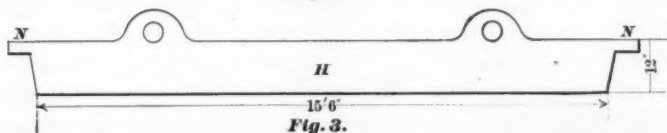
At the meeting November 28th, the following paper was read by Thomas D. West:

"METHOD OF CASTING TEST BARS FOR THE A. F. A. TESTING COMMITTEE."

There is no metal whose physical qualities are so easily and radically affected by thickness and rate of cooling as cast iron. A casting half inch thick and another four inches thick in steel,

Fig. 1.
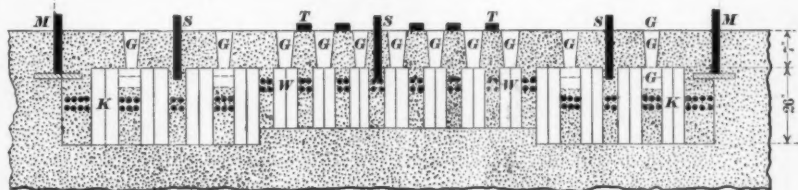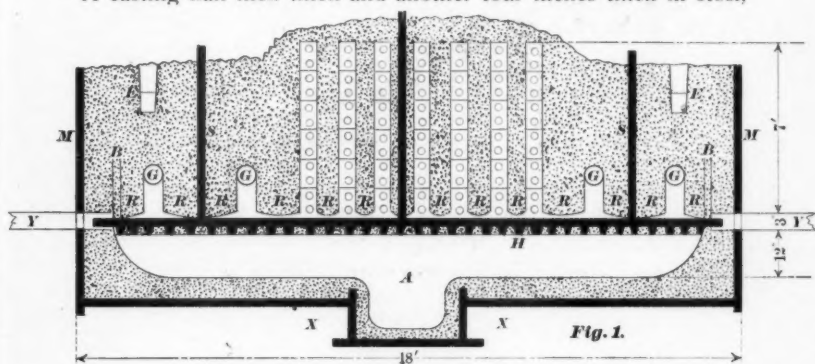
Fig. 2.

Fig. 3.

for example, show very little difference in the structure of grain, whereas such variations of thickness in cast iron may cause the light body to be very dense and hard, while the heavier body

will be open grained and soft. Then, again, we can take the same thickness in two castings and by cooling one more quickly than the other, cause one to be white, while the other will be gray in its body, all being poured from the same ladle of metal.

The rate of cooling is a factor as important in its effects in altering the structure or grain of cast iron as that of differences in the thickness of casting, and can be controlled in three ways:

Fig. 4.

First, by having the mold of sand or of iron. Second, by varying the nature and dampness of the sand, or thickness of the iron chill forming the mold. Third, by variations in the temperature or fluidity of the melted metal at the moment it is poured.

Variations in the pouring temperatures of metal often greatly affect the strength of iron, but in what direction, according to the grades used, is yet to be clearly established, as in some mixtures

a dull iron increases the strength, while in others the reverse is true, on account of the influences affecting the carbon in being combined or free in the iron.

A study of the various conditions affecting the grain of cast iron should demonstrate that any attempt to obtain comparative test specimens from which correct deductions can be expected, to define the physical qualities of cast iron, should be made on
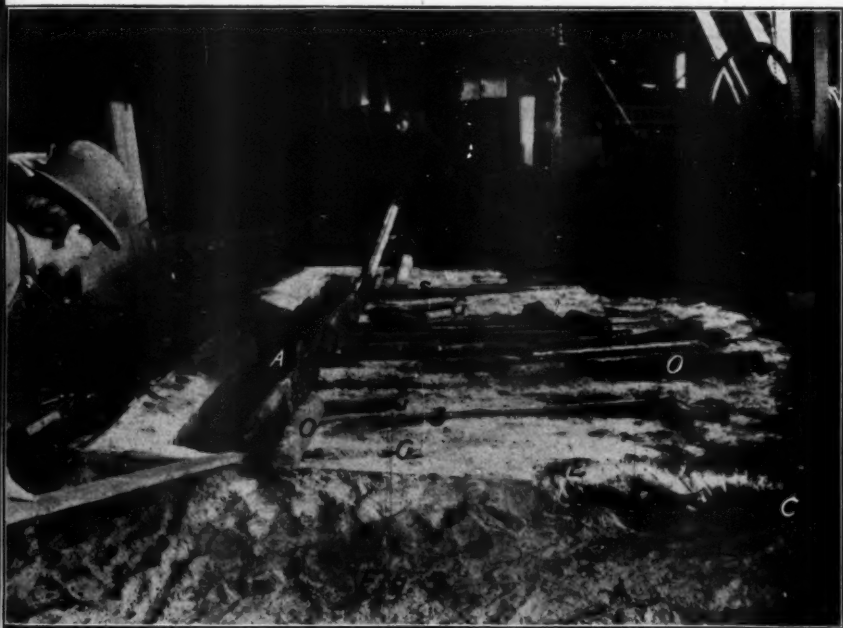
a plan which permits pouring at the same temperature, and casting in a position permitting the most uniform cooling and giving the most uniform grain in the specimens. These are conditions which the writer, in previous papers, has shown to be essential in making any sets of test specimens to be used for comparative purposes.

Very contradictory, or at least unreliable results are all that can be compiled from most all existing records of tests intended

to be comparative.   This is largely due to the intricate and delicate nature of cast iron and the want of practical knowledge of founding on the part of most experimenters.   It was in recognition of the great need of a more correct basis for comparing physical tests that the American Foundrymen's Association, at the suggestion of Dr. Richard Moldenke, appointed a committee at the last annual meeting to take up the work of showing what

Fig. 6.

cast iron is and what may be expected of it, in the production of castings and the use of different sizes of test bars.   To do this properly it is necessary to obtain test bars from more than one grade of iron.   It is an error to think that one grade will establish comparative records that would show what cast iron is. Instead of there being but one grade of iron to be tested, we have fully eleven grades which must be gone through before complete

records of any value can be had to represent the physical quali-
ties of cast iron. When it is stated that there are about 200 bars
in each of these grades of iron, ranging from ½ in. to 4 in. square
and round, 15 in. long, half to be made in green sand and half in
dry sand molds, the weight being nearly two tons for a single
set, or 22 tons in all, the magnitude of the work which the Amer-
ican Foundrymen's Association has in hand, as outlined by Dr.
Moldenke, will be recognized.

In starting this work, much time was expended in complet-
ing plans of procedure as the magnitude of the undertaking re-
quired that every step be well studied to make sure of giving
the best that was possible to attain the true strength, contraction

Fig. 7.
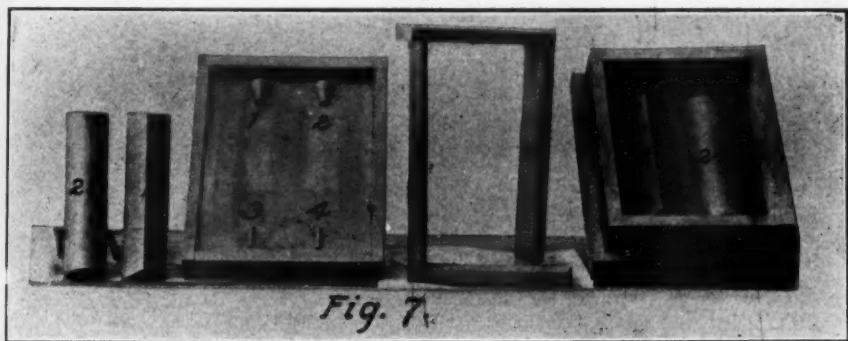
and chilling qualities of cast iron, as it is used to-day. After all
plans were arranged, the work of constructing the patterns, core
boxes and flasks was taken in hand and furnished by Dr. Mol-
denke and myself. Designing the method for casting these bars,
and making the first set was assigned to the writer. Knowing
the importance of casting on end and pouring all bars in any set
(to be used for comparative purposes) from the same ladle of
iron, and if possible, at the same time and temperature, the writer
originated the plan shown herewith, which has proved most suc-
cessful and embodies principles that may be utilized to advan-
tage in other lines of founding.

To give a general idea of the character of this work, before
proceeding to details, the reader is referred to the illustrations.
Fig. 1 is a plan view of the molds with their runners and gates,
before being weighted down ready for casting.   Fig. 2 is a sec-
tion behind the inlet plate H.   Fig. 3 is a working sketch of the
inlet plate H.   Fig. 4 a plan of the cores and green sand mold
as they appear in the pit before the last ramming around the
bodies was done.   Fig. 5 is a view of all the molds and their run-
ners just before casting.   Fig. 6 shows the act of pouring, before
the inlet plate H is lifted, but by reason of the gases escaping from
the cinder bed under the reservoir runner A, the picture is not
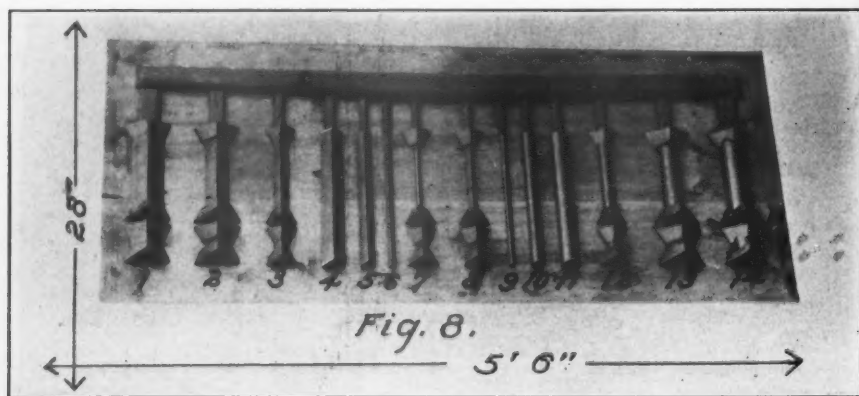
Fig. 8.

as clear as it might have been.   Fig. 7 is a view of the core boxes;
the one on the right shows the box together, the one on the left,
when it was taken apart.   Fig. 8 is a face view of a mold board,
showing the arrangements of pattern and gates; the same is to
be said of Fig. 9.   Fig. 10 shows a flask closed and on end ready
for pitting.   Fig. 11 gives two views of the tool used for printing
tits in the molds to measure the contraction.   Fig. 12 is an end
and side view of cores used in molding the tensile test bars.   Fig.
13 is an end and side view of the pattern used at G to form runners
over all the cores as at W (Fig. 2).   Fig. 14 shows the form and
plan of casting to obtain knowledge of the chilling qualities of the

various grades, and which is told by breaking the castings
through their centers on a testing machine. The castings, as
seen, are made in a wedge form running from a sharp edge to
4½ inches thick. This permits the one form and size of a casting
to be used throughout all grades, a plan essential to obtain a
comparative knowledge of the difference in the chilling quali-
ties of the various mixtures which will be tested. These chill
tests are made in a core as seen at D, Figs. 4 and 14. The faces
of these cores are covered with part chill and part core, as seen
at E' and H', Fig. 14. The chill E' is 1½ inches thick.

Fig. 9.
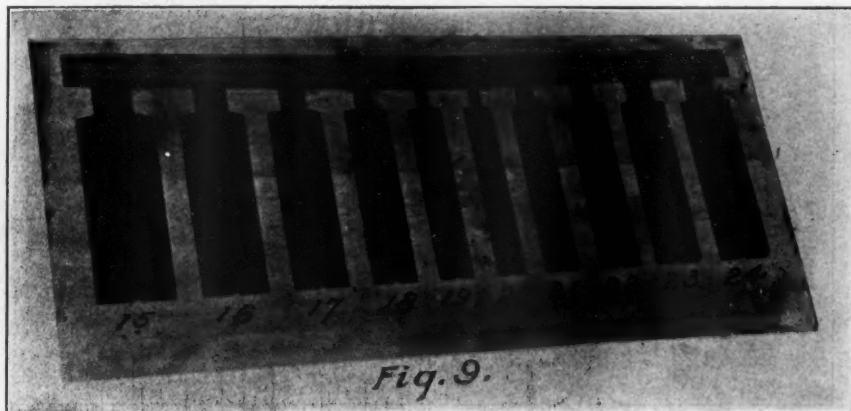
A fluidity strip ⅛ inch thick at the base running up to a
knife edge 14 inches long, as seen at X', is gated in connection
with the large casting K' as at R', Figs. 14 and 15, so that they
can fill up only as fast as the chill castings do, which prevents
any sudden dash of metal from giving a false effect in recording
the fluidity of the metal. The length of these strips will give a
fair idea of the difference which may exist in the fluidity of the
different shops' metal, or if any dull iron was used at the moment
a set of bars is poured. These fluidity strips will also serve to
assist in defining the chilling qualities of iron in combination
with the large casting K', as it is to be remembered that the hot-

ter or more fluid metal is poured, the deeper it will chill, another evil or irregularity due to non-uniformity in pouring temperatuers, which the writer has proved by previous experiments.

Fig. 15 affords a view of the first cast of test bars and chill tests, as they were taken from their molds and cleaned ready for shipment to the testing laboratory. Those on the left with flat gates were made in green sand, while those on the right with round gates were made in cores. Preparing for and making this first set of test bars involved about 30 days' labor.

Fig. 10.
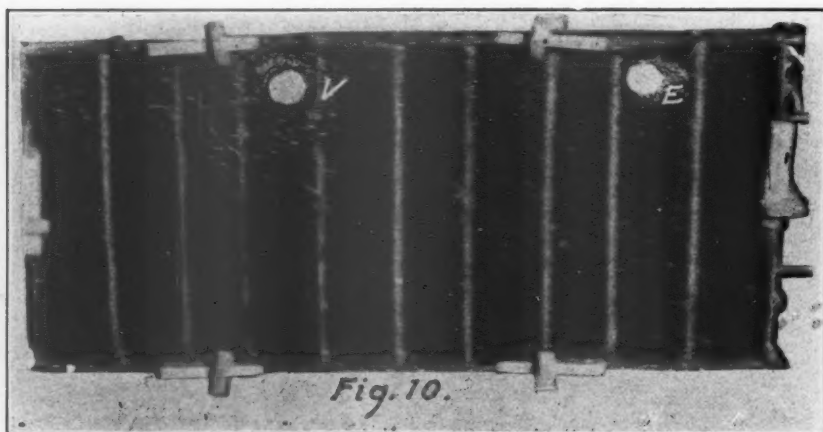
Figs. 16 and 17 give views of the second casting of test bars, which were made by the Westinghouse Electric & Mfg. Co., Allegheny, Pa. Fig. 16 shows the mold ready for casting. The gentlemen in the background, viewing the mold are: at the left, J. S. McDonald, foreman of the Westinghouse Electric & Mfg. Co.'s heavy work, foundry department, and also member of our committee on testing; then Dr. R. Moldenke, chairman of the committee, who, with Mr. McDonald is watching closely that all the work of making the test bars follows the original plan; next in order Benj. D. Fuller, general foreman of the Westinghouse Electric & Mfg. Co.'s iron foundry department, and last, C. F. Knowlton, foreman of this company's pattern shop. A study of

Fig. 16 will show that the exact plan used by the writer in casting the first set of test bars is followed, and that he did not originate a plan impractical of duplication. Fig. 17 is of value in showing the action of pouring after the inlet plate H, as described at Figs. 2 and 6, has been raised, to let the metal flow instantaneously to the molds, as Fig. 6 is only a view of the action of pouring before the inlet plate H is raised to admit the metal from the basin A to the respective molds. The Westinghouse Co. is kindly allowing Mr. McDonald to make two sets of these bars, and at this writing he is about ready to pour his second set. After this is finished, J. S. Seaman, of the Seaman, Sleeth Co., roll manufacturers, of Pittsburg, will receive the flasks and rigging, and thus they will be transferred from shop to shop

until the whole 11 sets, or nearly 22 tons of test bars are completed. All having taken part in this important work will be given full credit in the report which the committee will present, giving the results of the test of all the bars. It is but just to remark that it requires experience in founding and men of ability to successfully oversee and mold up such a set of test bars after the plan herein described, but judging from the character of the men and firms who have consented to do this work, all may rest assured that the end sought will be as nearly attained as is possible with our present knowledge.

The flasks used for this work were all made of malleable iron so as to make them strong and light for handling. The cross bars were arranged in the flasks so as not to come over the part of the test bars which should fracture when tested, after the plan seen in Fig. 10, which is a flask taken from the mold board, Fig. 8. In mixing the facing sand for these molds, half

new and half old sand, with 1 to 20 of sea coal, was used for board,
Fig. 8.   For the heavier patterns, seen on board, Fig. 9, the fac-
ing sand was mixed with 1 to 12 of sea coal.   To form the re-
cesses of separation of the long and short tensile test bars, as at
P., Fig. 8, cores as at Fig. 12 were used, by placing them in the
pattern and ramming them up with the mold.   This is a little
wrinkle that can often be used to good advantage in cases where
green sand bodies are thought to be too small to stand the drop
or wash of metal.   These bars are used to obtain the tensile
strength, while the straight ones seen on both boards are for
transverse tests.   In ramming up the flasks, a gate and riser was

Fig. 12.
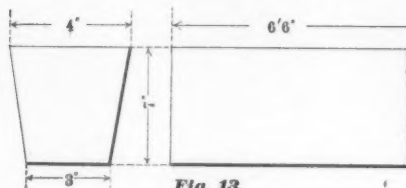
Fig. 13.
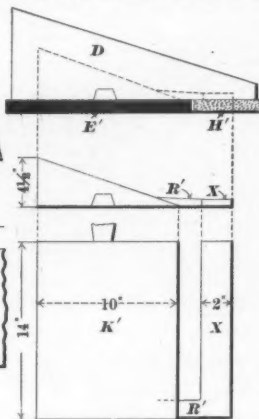
Fig. 14.

set on the main runner at L to look as at V and E, Fig. 10.   It
will be noticed that the runners L slope from the middle up to
each end.   The idea of this is to cause the first dash of metal to
go direct to the smaller bars to assist in assuring their running,
as in chill or hard grades of metal there is often difficulty in run-
ning light bodies.   In ramming the sand in the flasks, care was
exercised to ram it evenly and firmly, so that no swelling or scab-
bing can take place.   Much care is also taken in venting as well
as in finishing the mold.   The swab was only allowed to be used
at the junction of the gate and pattern at I, seen in Figs. 8 and 9.
The reason for this is that if one part of the face of a mold is of

a damper sand than another, it will cause an uneven texture in the grain of the iron, and hence every precaution was taken not to use the swab anywhere near that portion of the bar, which will break when tested.

Some will wonder why, to get the dry sand effect, in making the test bars, we did not mold them in iron flasks and dry in an oven upon the plan generally followed for dry sand work. The reason this was not done and the plan of making them of cores adopted, was that not all of the shops that would be kind enough to assist in this work, have drying facilities for flask work. In making a sand mixture for the cores, it was very desirable to have it of a character to crush easily when the bars commence to contract. After some experimenting the following mixture was adopted for making the cores:

      1 part lake, river or bank sand.
      3 parts of fine white silicon or crushed sand.
      1 part of rosin to 25 parts of sand.
      1 part of flour to 25 parts of sand.
      1 part glutrose to 30 parts of sand.
      Wet balance with water.

This sand mixture is one that possesses very little body to stand up in a green state; so much so, that in making the larger cores rodding is very necessary in order to keep the cores together. When this mixture is dry, the cores are exceptionally strong to handle; much more so than any made with a more loamy sand, having flour only for a bond. The effect of the above mixture when heated with molten iron is such that after solidification the core softens to such a degree as to cause practically no resistance to contraction taking place. Such a core mixture could be found of much value in work where, on account of the inability of cores to yield, castings have come out cracked, an evil with which many founders contend. These cores are all made in halves, and after being blackened, which is done in a green state with the large cores and in a dry state with the small, they are pasted together and after being dried are then

ready to be set on their ends, in the ramming pit as at W, Fig. 2. The patterns seen on the mold boards, Figs. 8 and 9, are also used for making the cores, as can be seen by a study of Fig. 7, which shows the core boxes when together and apart.

The next operation to be noted is that of pitting the molds and cores. By referring to Figs. 1 and 2, a pit 18 feet long by 8 feet wide by 2 feet 8 inches deep, is seen to be necessary for this work. After the flasks and cores are set on level beds, as at Fig. 2, sand is filled in and rammed around the mold and

Green Sand Bars   Dry Sand Bars

Fig. 15.
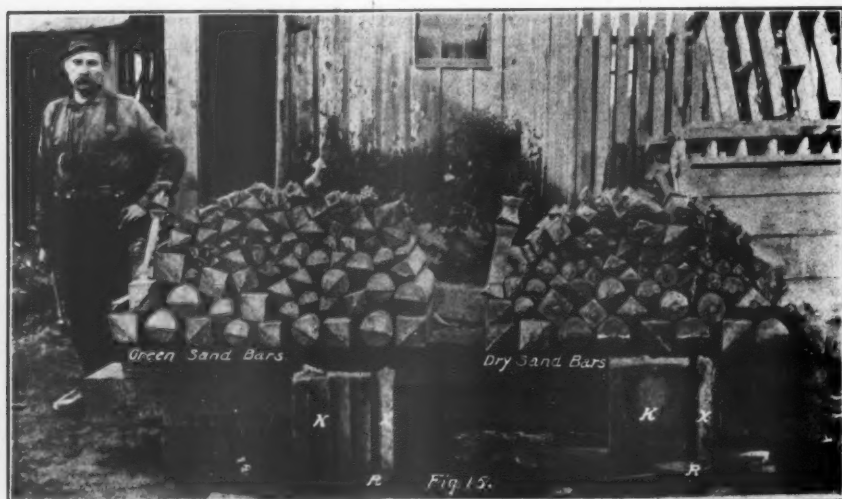
cores until the levels of K and W are reached, when a double row of vents are made down each side of the cores and flasks. This completed, a bed of fine cinders, as seen, is laid in between the cores and molds and also brought out to come in under the pouring basin A. These cinders are covered with straw or hay and the whole covered with sand. This done, the cores to form the gate connection G and riser E, as at Fig. 1, are placed in position. This brings the work up to a point as shown by Fig. 4. To keep dirt from dropping into the·molds through the gate holes seen in the cores W, while sand is rammed between them, boards, not

shown, cover the holes, and being weighted down remain stationary.

When the pit is rammed up to a level of the flasks and cores, the boards covering the cores are then removed, after which long runner patterns of the form seen at Fig. 13 are then placed over all the cores to form runners to connect with the main basin A as seen over W, Fig. 2. This done, plates are set on edge as at M, S and X, after which the inlet plate H is set up against the

Fig 16
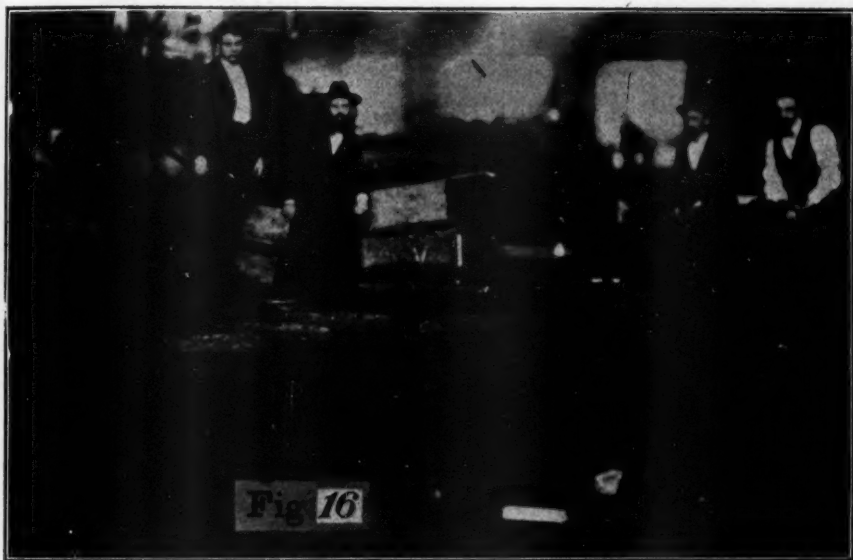
plates S, and plates as at B set against its ends, after the manner shown. This completed, a board 12 inches deep by 15 feet long is braced 11 inches away from the face of H and the whole bed is then rammed up and finished to appear as seen at Fig. 5. This cut also shows men in position to test lifting the inlet plate H by means of levers Y, resting on the plate M, to come under lugs N. Stops, as at P, prevent the inlet plate being lifted to any greater height than $2\frac{1}{2}$ inches, which insures only clean metal passing to the molds, as when the basin A is filled by the ladle U.

as seen in Fig. 6, all dirt must be confined and remain upon the surface of the metal in the basin A.   To form the basin A and its adjoining runners, separated by the inlet plate H, special care is exercised to prevent the sand forming a division between the runners at the points R, Fig. 1, from being lifted or disturbed in any manner to create dirt, when the inlet plate H is raised to let the metal flow to the molds. This is done by hoisting out the inlet plate H entirely clear of the molds before the runner patterns are drawn and shaving or trimming the sand at the rear of the inlet

Fig. 17

plate to form a clearance at the face of the runners R, as shown. By thus trimming the sand, the only back support left for the lifting plate H is that afforded by the ends of the plates S and B, which is all-sufficient, and works as nicely as could be desired. After the divisions at R between the runners have their ends trimmed off for clearance, the runner patterns are all drawn and any dust lying upon the surface of the cores, which form the bottom of the runners, is then cleaned up with a small camel's hair brush, occasionally moistened in oil, to cause the dirt to stick to

it. This work completed, the inlet plate H is lowered to place and care taken to know that it has a solid bearing along the whole length and width of its bottom surface, which is three inches wide.

Two risers are carried from the two outside flasks, as at E, and left uncovered when casting so that when the molds are filled all surplus metal remaining in the basin and runners can flow out readily to pig pits having a lower level than the pouring basin and runners as seen at C, Figs. 5 and 6, thus leaving the molds disconnected to be removed singly from their casting pit, after the gate connections between flasks at G are broken. This can be done while the connecting gates are hot or cold, as best suits the pleasure of the molder.

The purpose of the plan herein illustrated is to present ways by which any large number of test bars to be used for comparative purposes may be poured from one ladle and at the same time. The basin A being, as shown, one foot wide and deep, gives a body of fluid iron weighing about three tons, uniform in temperature. And when it is said that from the moment the inlet plate H was lifted to the time the 200 test bars weighing exactly 3,780 pounds were all poured, scarcely 20 seconds passed and no bars were lost, all will realize the success achieved.

Never in the history of founding has a comparative set of test bars been cast, so well calculated to give the engineer and machine builder a correct basis for computing the strength, contraction and chill of cast iron in its rough and planed states. The writer trusts that Dr. Moldenke will be permitted to complete the great work he has undertaken in testing the many sets of bars which are to go to him from liberal members of the American Foundrymen's Association, and feels sure that the engineering and foundry world will await with great interest a report from the committee of the results which are now being obtained.

PROCEEDINGS OF THE
WESTERN FOUNDRYMEN'S ASSOCIATION.

The regular monthly meeting of the Western Foundrymen's Association was held Wednesday evening, November 16, 1898, at the Great Northern Hotel, Chicago. Vice-President Wm. Thompson presided in the absence of the president.

The secretary read the following amendment to the by-laws, proposed by P. D. Sloan, which is to be considered at the next meeting. It is an amendment to article II. of section 3, which reads: "The annual dues of each active member of the Association shall be $10, payable quarterly in advance." It is proposed to amend it to read as follows: "The annual dues of each corporation or firm shall be $10, but the annual dues for each person eligible to membership in this organization who is not engaged as a manufacturer or jobber in his own name shall be $5, payable quarterly in advance."

The paper of the evening entitled "Metalloids in Castings," by Major Malcolm McDowell, was then read, as follows:

"METALLOIDS IN CASTINGS."

Iron chemically pure is too soft for mechanical purposes, and is rarely found in native masses but mineralized in ores with different elements, metals and substances in the form of oxides, chlorides and fluorides, and when reduced to a metallic state these alloy and combine. Upon these alloys or combinations depends the commercial value of the ore.

The mineralized ores of iron are brought through the agency of the blast furnace to a metal of commerce, designated "pig iron," the constituent elements of which are of the utmost importance to the foundryman, for the value and usefulness of cast metal depends upon them.

"The allied metals with which iron will combine equally chemically and mechanically when reduced in a blast furnace are 13. Six of these are electro negative to it and seven electro positive. The electro positive are calcium, magnesium, beryl-

lium, zirconium, aluminum, manganese and zinc. Copper and
zinc are pyro-electro and change polarities with iron at different
temperatures. The electro negative metals are chromium, van-
adium, copper, cadmium, cobalt and nickel.

"The electro negative render iron electro positive, making
it cold short, having a crystalline fracture and a polished surface
is easily oxydized. The chill is well and clearly defined, white,
hard and brittle.

"The electro positive render iron electro negative, making
the iron tough, having an uneven or fibrous fracture and to a
limited extent resisting oxidation. The chill has radiant streaks
from gray back into chill of combined carbon, giving it a mottled
appearance, making the chill tough but not so hard as in the
electro positive."

The electro and pyro-electro conditions of metals are of in-
terest and may often assist to account for some one of the many
peculiar conditions of metal so often occurring, which the ordi-
nary chemical analysis takes no account of, as it simply deals
with iron, carbon, silicon, phosphorus, sulphur and manganese.
These alloyed or combined together in certain proportions make
what is commonly called "pig iron." The value of this metal de-
pends on these constituent elements and a practical knowledge of
them is what is desired by both the furnaceman and the foundry-
man—the former in making and grading his furnace product, the
latter in buying his metal and making castings to meet certain
requirements.

The output of pig iron in the United States for 1897 was as
follows: For basic open-hearth steel, 556,391 tons; for Besse-
mer steel, 5,795,584 tons; spiegel and ferro, 173,695 tons; foun-
dry and forge pig iron (including charcoal iron), 3,127,010 tons—
a total of 9,652,680 tons. For the first half of 1898 the output
was 5,249,204 tons, and this will reach before the end of the year
nearly 12,000,000 tons, of which over 70 per cent will be used
for steel and the bulk of the remaining 30 per cent for foundry
iron. The 70 per cent is sold to those who know what they want;
but a majority of the buyers of the balance do not know what

chemical constituents are required to meet their special needs, and rely on the sales agents to tell them. The sales agent, in his turn, sells what he has for sale, guessing and hoping it may meet the foundryman's wants, and sometimes it does, but frequently it does not. And when it fails there comes a protest from the foundryman. The sales agent is the only one known either to the furnaceman or the foundryman, in most cases, and his interest is to sell the largest amount of iron possible. He undoubtedly does it honestly to the best of his knowledge of what the metal is and what the foundryman needs, but in many cases neither the sales agent nor the foundryman knows anything of the merits of the various metals and metalloids which give value to the iron for making castings. The former shows to his customer a section of pig iron, and speaks in glowing terms of its merits and of the large amount of graphitic carbon it carries, as exhibited by the fracture.

The fracture or graphitic carbon, however, are not reliable factors in estimating the value of pig iron. The other constituent elements have much to do with the nature of the fracture, as have also the heat at which the iron was melted and the length of time it took in cooling. The fracture varies from a bright black, open, to a close, mottled, bright gray and black. The former indicates a large amount of graphitic carbon, and the latter the opposite, so that in grading one might be called No. 1 foundry and the other No. 3, judging from the fracture, while a chemical analysis of the pig would show something entirely different. As an illustration of this, a firm with whom I was engaged and submitted to them cards showing the analysis of two different cars of iron, guaranteeing the analysis. The seller was one of the largest pig iron dealers in the country, and the sales agent is noted for his honesty as well as for his knowledge of pig iron, as he was brought up as a furnaceman. But with all this back of the iron, as it was being unloaded each pig was broken and the iron graded according to the fracture. This was a peculiar case—the furnace selling according to chemical analysis, and the foundryman using the iron according to frac-

ture. As there was such a marked difference between the fractures of the two grades I took three pigs from each grade, and after removing the scale drilled each pig and mixed the drillings of each grade thoroughly, and sent them to Dickman & Mackenzie, of Chicago, for analysis, with the result seen in the table.

This is enough to illustrate that grading by fracture is quite likely to result in something entirely different from what one would expect to see, judging from the chemical analysis.

Pig iron is valuable to foundrymen in proportion to its rich-

	Silicon.	Phosphorus.	Sulphur.	Manganese.	Combined Carbon.	Uncombined Carbon.	Total Carbon.
Open	2.68	.345	.013	.59	.125	2.72	2.84½
Close	3.30	.366	.014	.55	.12	2.43	2.55

ness in certain metals and metalloids that combine with it in making castings, and silicon is the most important of these alloys. But silicon, carbon and iron will not make a good casting, for they need a certain proportion of manganese and in many cases phosphorus is a desirable element. Sulphur under no circumstances is to be considered; if possible, eliminate it.

It is the silicon that gives value to pig iron, and graphitic carbon is the evidence of its being in the metal, although silicon does exist in metal sometimes without a manifestation of graphitic carbon, as shown in the above illustration. The latter is, therefore, not a reliable factor on which to base the value of iron. Foundry pig should be graded and sold according to its silicon contents, as follows:

No. 1 foundry, 3.   per cent silicon, is worth, say........$10.75
No. 2 foundry, 2.75 per cent silicon, is then worth........ 10.50
No. 3 foundry, 2.50 per cent silicon, is then worth........ 10.25
No. 4 foundry, 2.25 per cent silicon, is then worth........ 10.00
No. 5 foundry, 2.00 per cent silicon, is then worth........ 9.75

All below two per cent silicon is gray forge or anything you may choose to call it. For any metal carrying less than two per cent silicon has no capacity for carrying even the sprues

and foundry scrap. Much less can it carry cheap cast scrap which is so largely used. And when it is undertaken to carry any of this in a mix where this so-called No. 2 foundry, which has less than 2 per cent silicon, is used, there must be added enough high silicon pig, carrying from 6 to 8 per cent silicon, to make a good machinery casting. When this is done, the mix costs more than a good first-class No. 2 foundry which carries over 2.50 silicon. A new name has been given to No. 1 and No. 2 foundry iron which carries over 2.50 silicon. It is called a softener. But this new name adds no new virtue. It is the same metal, and the most economical softener is a ferro-silicon of from 8 to 10 per cent silicon.

In the Iron Trade Review of March 31, 1898, is an article by Charles W. Friend on "Furnace Facts about Foundry Iron," and as it so fully illustrates my thought on the subject of foundry iron, I take the liberty of making use of its tables:

TABLE A, PURE PIG IRON.

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Silicon	1.15	1.50	1.60	1.80	2.00	2.25	2.50	2.60	2.80	3.00
Sulphur	.010	.012	.014	.016	.018	.016	.020	.024	.020	.022
Phosphorus ..	.60	.56	.58	.61	.55	.54	.61	.60	.51	.60
Manganese ...	.50	.52	.49	.45	.90	.50	.70	.45	.80	.35
Graph. Car....	3.60	3.10	3.20	3.40	3.00	3.70	3.30	3.80	3.50	3.70
Comb. Car. ..	.12	.35	.30	.25	.14	.12	.18	.16	.20	.06
Tensile Str ..	16,000	19,000	15,000	24,000	18,000	17,000	18,000	16,000	15,500	14,500
Trans. Str.. ..	1,800	2,100	1,700	3,000	1,600	1,700	2,000	1,500	1,600	1,400
Fluid..........	Flu.	Flu.	Flu.	Flu.	Flu.	Flu.	Flu.	Flu.	Flu.	Flu.
Soft............	Soft.	Med.	Soft.	Hard	Med.	Soft.	Soft.	Soft.	Med.	Soft.

TABLE B.

Same iron with 30 per cent good machinery scrap.

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Softness........	Soft.	Med.	Soft.	Hard	Hard	Soft.	Med.	Soft.	Med.	Soft.
Fluidity.......*t.*	Flu'd	Flu'd	Flu'd	Flu'd	Flu'd	Flu'd	Soft	Flu'd	Flu'd	Flu'd

TABLE C.

Same iron with 60 per cent good machinery scrap.

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Softness........	Hard	Hard	Med.	Hard	Hard	Soft.	Soft.	Soft.	Med.	Soft.
Fluidity.........	Flu'd	Flu'd	Flu'd	Flu'd	Flu'd	Flu'd	Flu'd	Flu'd	Flu'd	Flu'd

Nos. 1, 2, 3, 4 and 5, without an admixture of scrap, make a good soft medium casting, and Nos. 6, 7, 8, 9 and 10 make a good casting, carrying 60 per cent scrap. But Nos. 1, 2, 3, 4 and 5 are too hard for good machine castings.

Grading pig iron according to its silicon contents does not
necessarily make the price of the pig iron depend on it, for some
grades of pig iron carrying the same amount of silicon may be
considered more valuable because of the phosphorus or man-
ganese they carry. For many special purposes a pig iron high
in silicon, phosphorus and manganese and low in sulphur is more
valuable than an ordinary iron carrying the same amount of
silicon.

One of the many things for the foundrymen's associations to
do is to institute a uniform grading of foundry pig iron, so that
a number or name in one state is understood in any other, and
numbers and names mean something which all foundrymen can
know and understand, as well as furnacemen. I am confident
the furnacemen are ready and willing to assist and co-operate
with the foundrymen in establishing such a uniform method of
grading.

DISCUSSION.

Mr. Ferguson: Major McDowell states that "sulphur under
no circumstances is to be considered; if possible, eliminate it."
I know that in getting high mottled iron of great thickness, it is
desirable to have sulphur to assist in the mottling of the iron.
Every analysis taken from such iron as I speak of shows the
sulphur high; and in trying to get the same mixture when the
mottle is absent, the sulphur is low. This would lead me to
believe that under some circumstances sulphur is essential. Major
McDowell also says: "It is silicon that gives value to pig iron,
and graphitic carbon is the evidence of its being in the metal,
although silicon does exist in metal sometimes without a mani-
festation of graphitic carbon." Charcoal iron will run 1¼ or less
in silicon with the total carbon of over four per cent. I would
like to have the Major explain how he accounts for that if the
silicon controls entirely.

Maj. McDowell: You must always take into consideration
the circumstances. Charcoal pig is the exception; the rule is
coke pig. What we want to get at is what gives the character
to iron and controls its price. A man comes to you and says,
"This is a splendid quality of pig; see the graphitic carbon in it"
—as though graphitic carbon makes the iron. It is simply the
evidence of the presence of silicon. These two photographs

illustrate two pigs sold as No. 1 foundry with the analysis guaranteed by one of the most prominent agencies. In unloading the car I broke one pig and I picked up that close piece. We broke every pig and made these two grades. I did not expect to see the close piece analyze as containing three per cent of silicon, but it did and it showed it in its work. I feel that there should be a standard way of grading pig iron. Pig iron is valuable to different persons in different ways, but when we come to grading it we want to know, when we say No. 2 iron, what we are getting. When you are buying ten-penny nails, you know what you are getting. You cannot do that with pig iron. We do not want to regulate the prices. I used figures simply to
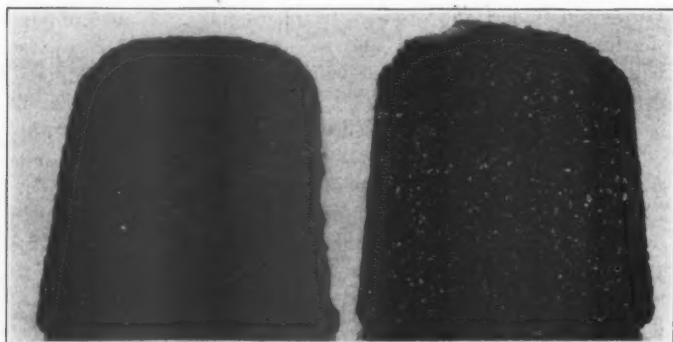
illustrate. Mr. Ferguson said a moment ago that analyses are of no use to foundrymen until they are educated. What we want to do is to agitate these questions until we do get to know what we want. I have been in quite a large number of foundries all over this country and I have found a great ignorance upon the subject. The foundrymen do not know the constituents necessary in pig iron to make the iron they want. The salesman sells the iron hoping it will answer the purpose, and the foundryman does not know any better than to buy it and then there is trouble and complaint. I want a more intelligent way of buying and selling iron.

Mr. Ferguson: I certainly agree with the Major that the foundrymen do not know how to handle the various metalloids for their various requirements, and, as he says, by agitating the

question we can gain a little knowledge. I still insist that it matters not to the foundryman whether his iron contains 2 or 2½ per cent of silicon unless he has the knowledge that enables him to control the silicon and other elements in the iron. I cannot get through me the matter of silicon being the controlling element in the value of pig iron. I know of an iron that carries 3½ silicon and 1½ manganese. It is in the market to-day and the foundrymen are using it. The other metalloids come into play.

Mr. McDowell: There are some elements that we know very little of to-day, as I have set forth in the beginning of my paper. Charcoal pig is a negative. It is what I would call an alkaline, while coke is an acid iron. You cannot do with coke pig what you can with charcoal pig. You say a great many things can be done, and the next day you do something that knocks your theories higher than a kite. I undertook once to raise the combined carbon in the iron and instead of doing that I turned it all into graphitic carbon. Sometimes manganese will make combined carbon and sometimes graphitic carbon. We do not know when or how. There is another question—carbon's relation to iron as affected by manganese. Iron, by itself, can be saturated with carbon up to 4½ per cent; manganese can be added to strengthen it so that it will carry 7½ per cent; then add chromium, and it will carry 12½ per cent. One is a positive metal and the other is a negative metal. There is a point where silicon does not make itself manifest in the iron. It is the same way with manganese, and there is a point where it makes the best iron made. That point is between 1 and 1¼ per cent, free from other metals or metalloids to embarrass the result. One and one-quarter per cent silicon and one per cent manganese gives the best iron made, if it is not embarrassed by phosphorus and sulphur. The sulphur should never be over .025 in the pig. I would ask Mr. Ferguson what mottled iron is? What is the object in making mottled iron?

Mr. Ferguson: To give strength and density.

Maj. McDowell: How strong can you make mottled iron?

Mr. Ferguson: I do not know that I can answer that. You cannot test it by an ordinary test bar, but I have gone to the trouble to break a six-inch square bar, 18 inches in the centers. It showed about 450,000 lbs. transverse strain. It pretty nearly broke the machine.

Maj. McDowell: We used to make mottled iron for chilled rolls. I have gone through the chilling process until I have eliminated sulphur entirely, and can make a stronger iron without sulphur than with it.

Mr. Moore: I can cite an instance in our own experience where we were fighting sulphur. At one time we downed it, and got some very low sulphur iron, getting our castings down to about .04 or .05. That is considerably below where we had gone previously, the range ordinarily being .06 to .07. The iron apparently was quite high in phosphorus and graphitic carbon. The result was that the castings were full of pin holes. We put in some scrap and brought the sulphur up to the normal point and the trouble disappeared. That is not conclusive evidence, but was our experience.

Maj. McDowell: A higher manganese would have corrected the trouble. Manganese intensifies iron's affinity for carbon, and eliminates the sulphur. We do not yet know to what extent we ought to use these, one against the other and to stimulate the other. If you add carbon to a metal it makes a hot metal. There is life to it. Carbon is the life of iron as well as of the individual.

Mr. Stantial: The Major has said what ten or twelve years ago any one would have said. He says that coke iron cannot be used for the purposes charcoal iron can be used. I would like to ask him one of these purposes.

Maj. McDowell: Chilled rolls. You cannot make chilled rolls out of coke iron, unless you produce a reaction in the cupola.

Mr. Stantial: Is that because of the state of the art?

Maj. McDowell: That is it. You will have to produce a reaction in the cupola similar to the blast furnace to make chilled rolls out of coke iron.

Mr. Stantial: Is it not a fact that chilled rolls are being made from coke iron to-day?

Maj. McDowell: Not to any extent. The largest manufacturer of chilled rolls in the country has never made them without using charcoal iron.

Mr. Stantial: Ten years ago no one thought malleable castings could be made from coke iron.

Maj. McDowell: There is a considerable difference in making malleable castings and making chilled rolls. What would

do in one case would be entirely wrong in the other. I have had considerable correspondence as one of a committee appointed some time ago to ascertain the value of metalloids in connection with iron. I have tried to get some of the colleges to take it up, but have not been successful. I finally induced the State College of Pennsylvania to investigate the question, and they have asked the Legislature to make an appropriation for the purpose. We only know to a very limited extent the value of the various metals and metalloids that combine with iron. We know very little of the value of the heat used in melting iron, as affecting the results. Some days we have a remarkable metal and a very remarkable heat. There are several things besides the metalloids that make the castings, and one of them, and a very important one, is the heat.

Mr. Moore: Speaking to the main point, as to the grading of iron by analysis and the determination of the value of the iron by the silicon it contains, it seems to me this would be feasible, provided there were enough in harmony with it. But I would suggest that there be two grades—two tables. The Major has submitted a table giving No. 1 foundry iron with three per cent silicon as a basis and dropping 25 cents a ton for each quarter point of silicon. Whatever value the quarter point may be, I would suggest another table for foundry iron with .03 in sulphur as a standard, or possibly .04, and for each point deduct 25 cents a ton. It is worth it. In purchasing iron I consider the cheapest way we can buy silicon is to buy high silicon iron. There is a difference between the market price of 8 per cent silicon iron and No. 3 foundry iron of about $2 a ton. If you buy an iron which runs from 1 to 1½ per cent silicon, and buy eight per cent silicon iron at $2 per ton more, you can increase the silicon in the first iron by using the high silicon mix at an additional cost of about 30 cents a ton. If you buy foundry iron to equal that it will cost you possibly 50 cents a ton to get the mixture up to 2½ per cent silicon. I would like nothing better than to have this question fought out with the furnacemen. Reverting to the question of low sulphur, I take it that Maj. McDowell agrees with me that whereas sulphur did better than we thought it did, manganese would have been a much better agent for our purpose.

Maj. McDowell: A paper which I read here some time ago had a larger table with reference to grading iron, and referred

to the amount of sulphur that would be permissible, and when it exceeded that amount there would be a reduction in the price of the iron.

Mr. Coffeen: There is one question I would like to ask the Major. In grading foundry iron do you think it necessary to take into account the amount of carbon, or do you think you can control the carbon in controlling the other elements? Mr. B. S. Summers had an article in The Iron Trade Review recently which dealt somewhat with this question, and a short time ago I asked him about it. He attaches a good deal of importance to the amount of graphitic carbon in the pig iron.

Maj. McDowell: Carbon in iron is valuable in proportion to the amount contained and its relation to the iron.

Mr. Chamberlain: One thing mentioned here set me to thinking. In speaking of technical schools taking up this question of analysis of iron and mixtures, it strikes me that it can scarcely be done by the schools, except at very great outlay, as it is very difficult to get in laboratory work the actual conditions which you will find in foundries. From that point of view it seems to me that the data must necessarily come from the foundries. If the combined knowledge of foundrymen could be tabulated it would be a fund of data invaluable in drawing conclusions. If the analysis of the pig and scrap, the fuel, and the product, the physical test, the temperature of the furnace and of the iron as it was run, the nature of the sand, and the proportions of oxygen supplied to the blast, were all taken close account of, it seems to me that there would be no trouble in reproducing any heat. I think the greatest advance in the subject of foundry practice is going to come from the data furnished by the foundrymen themselves, and the greater the amount of exact data procurable the greater the good to be obtained. The old tendency of the arts to keep secret that which was learned to be superior is rapidly passing away, as is evidenced by this society and other societies, which are composed of men interested almost entirely in the dollars. It is not love of science which brings these men together to discuss the arts, but the interest in the gain of dollars. It seems to me that if some method could be devised for reporting the results of various heats a great deal of valuable data could be formulated to aid in further developments.

The meeting then adjourned.

A REVIEW OF THE FOUNDRY LITERATURE OF THE MONTH.

AMERICAN MACHINIST.

NOVEMBER 17th.

This journal publishes an article by Henry Hansen upon "Bench Molding." This branch of foundry practice is entitled to more consideration than is commonly accorded it, for, though the castings are small, they are very numerous. There is a notable lack of facilities for making this class of work in foundries generally, which is usually the fault of the foreman. This want of proper facilities is what gives molders an aversion to light work. The bench and the snap flask are handy in all foundries, and where these, as well as sand, and all other accessories are suited to the work, the product will be correspondingly excellent, whereas, without these, good work is not to be obtained with economy.

The bench is serviceable also in molding in small wood, and iron flasks.

Castings made in snap flasks often present the appearance of having been strained in pouring, whereas the fault may be in disproportionate ramming of drag and cope. When the patterns are on a follow board, the drag should be rammed harder than the cope, to insure against yielding in places under the ramming of the cope.

Another common fault in bench molding consists of driving the draw plug into the hole. The draw plug should be made of hardwood, properly tapered, and split at the end, to give it spring, and then it will stay in place by merely pressing it in by the hand.

Weights used on snap molds should be level on the face; also, the strike and the top of the flask should be true in order that the top of the mold shall be level; if, in addition to this the bottom boards be level, and heavy, the danger of bursting out or straining will be greatly reduced.

As a matter of fact, light work requires a high order of skill to insure the best results in making it.

Thomas Wathey gives directions for mending cast iron. He says:

The best way to do this job is as follows: Get your cores, or what you are going to use to surround the hole with, ready. Then put a fire on the casting and get it as hot as you can; that is, red hot if you can. Put your cores on, weight them down so that they will not be washed away, and pour with good hot iron. As soon as cast, clear away the cores from around the patch before it gets hard; then get the hammer and beat all round the edge of the patch until it is near the same heat as the other part of the casting, then put on a charcoal fire, let the fire die out and let it stay there until it is thoroughly cold.

A good mixture is put around a hole in a casting, that will not burn off when a fire is built, is this: Mix new molding said one part; plumbago two parts; make it into the right consistency with a little water, then place it around the hole to be patched, and it will be ready when the fire is taken off to pour, and it will not burn away. I have tried it several times and have found it all right.

Nov. 24: R. H. Palmer has in this issue an illustrated article on "Casting a Corliss Cylinder." The character of this article is such as to preclude the possibility of summarizing. The illustrations comprise twelve figures which, with the text, give a minute description of the processes of molding a large jacketed cylinder, the making of the cores and the casting also being described.

THE FOUNDRY.

I. B. Thomas describes an ingenious method of cataloguing patterns, which he terms the "card system." In his own case a five-story pattern storeroom was supplied with shelves divided into sections, and having a platform midway of each story. The four tiers of shelves, with aisles between, were lettered, and the sections were numbered like houses on opposite sides of a street. Shelves above one another were given the same number with the important exception that a new hundred was given to each ascending half-story. Thus, from 1 to 200 are on the first floor

under the midway platform, and from 200 to 399 on first floor above platform. Each pattern was stenciled with its number and letter to correspond with section and shelf, and two cards bearing the proper number of the pattern were provided. These cards are very simple and contain all needed data concerning the pattern, and make the locating of it easy and expeditious.

C. F. Logan writes on "Chill Roll Making," taking the ground that though internal strains are the cause of excessive breakage, yet the cause of the strains is not to be found in the iron content, but in the methods of molding and casting.

R. D. Moore, in a continuation of his series of papers on "Useful Foundry Hints," discusses the question, Why does a chilled roll crack in cooling? He says: "Nearly all late writers and mechanics appear to have overlooked the old classification of iron as cold-short and red-short, the latter being the strong metal. Rolls made of it cannot stand the severe stretching made necesasry by the chilled skin being rapidly cooled and still prevented from shrinking by the pressure of the fluid iron inside the shell holding it against the chill. The remedy for these splits in chilled rolls appears to be * * * reduce the red-short by adding the cold-short property in the mixture till the necessary red-toughness is obtained." Mr. Moore gives an example of his experience seeming to verify his position. In further "hints" he treats of methods for splitting cog-wheels and pulleys, where they are required to be in halves.

John C. Knoeppel has an article on the "Cast Iron Column of 1872," wherein he says that it was the practice of that day to test the strength of the column to one-third more than the column was required to bear.

Arch. Loudon is the author of an illustrated article describing the methods of molding and casting a large hydraulic valve weighing about 28,000 lbs., including 2,000 lbs. of brass used in lining the cylinder.

Mr. Keep, in the department of Cast Iron Notes, criticises a paper read by Bertrand S. Summers at the Buffalo meeting of

the American Institute of Mining Engineers, and which paper also appears in this issue. Mr. Keep strongly maintains that silicon is effective in controlling the graphitic content of iron in the operation of melting in the cupola, notwithstanding Mr. Summers' doubt of the same.

A Reservoir Substitute for Ladle is illustrated and described by John Pettigrew. In this cheap, but thoroughly efficient reservoir he was enabled to store about 19 tons of molten iron "good and hot, for nearly three hours,' when it was tapped, and the iron ran through a trough into the mold.

THE TRADESMAN.

Writing on the subject of "Flask Hinges," E. H. Putnam says: The hinge of v-shaped section is perfection for the purpose to which it is applied. The outer up-curve of the hinge on the drag should not extend above the edge of the drag: 1st, because it can serve no possible utility to have it do so; and, 2d, because it sometimes would interfere with setting the drag on the follow board, and, 3d, because it would be more liable to get broken. The hinges should be so adjusted upon the flask that they will hold the joint of flask open from 1-8 to 3-16 of an inch, thus insuring a perfect rest upon the hinges, and so preventing the libaility of shifting incident to improperly adjusted hinges. The screw-holes by which they are attached should be located so that the screws shall be as far as possible from the joint so that hot iron and burning gas shall not loosen them.

THE IRON MOLDER'S JOURNAL.

publishes an article by "Heptagon," illustrating and describing the methods of sweeping up a branch-pipe, which, of course, cannot be summarized. Also, an article by R. D. Moore telling how to test the sufficiency of ramming before closing the mold. Mr. Moore also treats upon the pressure of iron on cores, and philosophises on vent. He says that lighting the vent does not prevent blowing or scabbing, and is useful only to prevent explosion in places where large volumes of gas may be gathered.

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